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Depositional environments and diagenesis of devonian black shales (Case study volga-ural Region, Russia)

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Abstract

© SGEM2018. The objects of research were carbonate-siliceous rocks of Semiluk and Mendym horizons of Upper Devonian formations from Volga-Ural region, Russian Federation. The main purpose of studying was a comprehensive investigations Devonian black shale and an assessment of their resource potential as objects of future exploitation for oil (unconventional shale oil formations). It was shown that the Upper Devonian black shales and their analogues have widespread on the territory of the eastern part of the Russian platform. Their main features are high content of hydrocarbons and kerogen and low permeability values. Reconstruction of depositional setting showed that rocks were formed in shallow epicontinental marine basin (depths up to 1 km) during periodic hydrothermal activity and frequent changes of oxidation and reduction environments. Such conditions were good for conservation of organic matter in sediments. It was found a significant influence of endogenous processes on the formation of variability of rocks along the cross section. Endogenous factor is periodic hydrothermal effusions, caused significant changes in sedimentation processes. It led to frequent changes of carbonate and carbonate-siliceous precipitation. Black carbonate-siliceous layers with organic matter are alternating with gray carbonate layers without organic matter, throughout the thickness. Moreover, precipitation of carbonate rocks was in oxidizing environment and co-precipitation of the carbonate and siliceous material was in reducing environment, which resulted in good preservation of the organic material. Diagenetic transformations have not been studied enough for Upper Devonian black shales. Current depths of occurrence are 1500-2000 m, reservoir temperatures of 30-35oC. It is not enough for oil generation processes. However, the first data on the study showed that the paleotemperatures at some stages of the basin evolution reached 100-120oC and organic matter partially realized its source oil potentially, by method of fluid inclusions analysis of digenetic minerals, as well as analysis of the data of pyrolytic studies of organic matter by the Rock-Eval method. In modern geothermal conditions, the Devonian shales cannot be considered as source rocks. However, these objects have increase attention from geologists. Geologists in region have already begun work on the use of a variety of technologies and the extraction of hydrocarbons from them, primarily based on hydrofracturing technology and heating of the productive part of the formation.

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Keywords

Depositional environments, Devonian black shales, Diagenesis, Hydrocarbons, Source rocks

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